Ontario

Apprenticeship
In-school Curriculum Standards

Plumber

Level 2

306A

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Introduction

This new curriculum standard for the Plumber trade is designed from the learning outcomes, which were developed from the industry-approved training standard.

The curriculum is organized into **3 levels** of training, each including reportable subjects containing learning outcomes to reflect the units of the training standard. The hours charts indicate how the curriculum can be delivered in the current block release format and summarizes the hours of training for each reportable by level. Since the reportable subjects are all divisible by three they can be adapted to accommodate a more flexible training delivery other than block release.

The reportable subjects are cross-referenced to the training standard for ease of comparison.

Each reportable subject and learning outcome identifies a recommended number of training hours. This hour allotment is broken into hours for instruction in theory and practical application. The division of the curriculum into reportable subjects follows a natural progression of learning through the training program. This structure will allow training centres and apprentices' flexibility in program delivery while still observing the importance of sequencing learning in a logical progression.

The curriculum is framed by and includes specific references to terminal performance objectives in the Apprenticeship Training Standards for Plumber. However, the curriculum identifies only the learning that takes place off the job, in a training environment. The in-school program focuses primarily on the theoretical knowledge required to master the performance objectives of the Training Standards. Employers are expected to extend the apprentice's knowledge and skills through appropriate practical training on the work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to assure that all apprentices have achieved the learning outcomes identified in the curriculum standard. The balance between theoretical and practical evaluation is identified for each unit of learning outcomes.

Implementation:
January 2007

Stakeholders Information

A consortium of five colleges of applied arts and technology, working in collaboration with the MTCU (Ministry of Training, Colleges and Universities) and industry stakeholders, participated in the development of this document. A Project Steering Committee (PSC) was struck to guide the project development process for the Plumber documents.

The PSC worked with industry representatives during the development of the curriculum to ensure content validity. During various stages of the process, the PSC and participating industry advisory groups evaluated the draft curriculum documents and provided feedback and recommendations for revisions. The format that is used in this document has been approved by the MTCU.

Program Summary of Reportable Subjects

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
S00027	Plumbing Systems – Level 2	120	111	9
S00028	DWV Piping Systems	48	0	48
S00029	Trade Calculations – Level 2	24	24	0
S00030	Trade Documentation – Level 2	24	8	16
S00031	Welding – Level 2	24	3	21
	Total	**240**	**146**	**94**

Number: S00027.0

Title: **PLUMBING SYSTEMS – LEVEL 2**

Duration: 120 Total Hours

Theory: 111 Practical: 9

Prerequisites: S00021, S00022, S00024, S00025

Co-requisites: S00027, S00028, S00029, S00030

Evaluation Structure

Theory Testing	80%
Application Exercises	10%
Final Assessment	10%

Instructional and Delivery Strategies

Complete a number of elevation drawings and drain plans incorporating the learning outcomes and content of Level 2.

PIPE AND FITTING MATERIALS, PIPE SUPPORTS, AND HANGERS:

Number:	S00027.1	
Title:	**Drilling and Notching**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00021, S00022, S00024	
Co-requisites:	S00028, S00029, S00030	
Cross Reference to Training Standards:	U5455, U5457, U5458, U5460, U5461, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize floor joists, wall studs, and roof trusses and identify which structural and non-structural members may be drilled and/or notched to a given size and in given locations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

1.1 Identify common structural members, such as:
- floor joists
- wall studs
- floor and roof trusses
- top plates
- bottom plates

1.2 State which structural and non-structural members may not be drilled or notched.

1.3 State the maximum size opening that may be drilled into a floor joist or wall stud of a given size.

1.4 Identify where a floor joist may be drilled in relation to the top and bottom of the joist.

1.5 State when and/or where a structural and non-structural member may be notched.

1.6 Identify backing plates and protection plates and state their function.

1.7 Explain where backing plates and protection plates must be installed.

Number:	S00027.2	
Title:	**Sleeving**	
Duration:	Total Hours:	6
	Theory:	6
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00021, S00022, S00025	
Co-requisites:	S00028, S00030	
Cross Reference to Training Standards:	U5455, U5457, U5458, U5460, U5461, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify different types of sleeves, construction, materials, applications, installation, and sealing procedures.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

2.1 State the purpose of sleeving.

2.2 List the different materials used for sleeves.

2.3 Identify the types of sleeves that must be filled prior to a concrete pour.

2.4 Define the terms:
- "temporary sleeve"
- "permanent sleeve"
- "waterproof or watertight sleeve"
- "sleeve template"
- "fire stopping"
- "insulation"

2.5 State the recommended length of a temporary sleeve.

2.6 State the types of materials that may be used for permanent sleeves.

2.7 State what materials may be used to create a watertight joint between the sleeve and the pipe.

2.8 Identify how to secure a sleeve prior to a concrete pour.

2.9 State the sleeve size for a given pipe size.

2.10 Explain the use of a sleeve template.

2.11 Create a plan view showing the location, number, and diameter of sleeves for a given plumbing installation.

DRAINAGE SYSTEMS:

Number:	S00027.3	
Title:	**Drainage Terms and Definitions**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457 U5458 U5459 U5460 U5461 U5462 U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify and apply drainage terms and definitions.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

3.6 Identify the code that lists the common drainage terms and definitions.

3.7 State the section of the Ontario Building Code (OBC) that contains drainage terms, definitions, and abbreviations of proper names.

3.8 Define the following terms, identifying minimum pipe size, installation or system location, and other distinguishing characteristics:

- "accessible"
- "backflooding prevention"
- "developed length"
- "fixture standards"
- "fixture unit"
- "horizontal branch"
- "interceptor"
- "plumbing appliance"
- "rainwater leader"
- "sanitary unit"
- "storm drainage system"
- "trap"

- "trap arm"
- "venting system"

3.9 Identify and list some of the common drainage terms and definitions by examining a drain plan and stack elevation drawing.

Number:	S00027.4	
Title:	**Sanitary and Storm System Design**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457 U5458 U5459; U5460 U5461 U5462 U5465 U5466 U5468	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize and design drainage systems, incorporating different drainage system designs.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

4.1 Explain and apply terms:

- "municipal sanitary sewer"
- "municipal storm sewer"
- "combined building sewer"
- "combined building drain"
- "semi-combined building sewer"
- "semi-combined building drain"
- "running hand hole trap"

4.3 Review the definitions of separate building sewer and separate building drain.

4.4 Explain the terms, "combined and semi-combined drain system".

4.5 Identify the components of a running hand-hole trap.

4.6 State where the cleanout must be installed with a running hand-hole trap.

4.7 State where a running trap must be installed in semi-combined and combined systems.

4.8 Identify the connection of a foundation drain and how a down spout connection is made to separate drainage system
- semi-combined drainage system
- combined drainage system

4.9 State where combined and semi-combined drainage systems may be found in service.

4.10 State where a separate system may be installed.

4.11 Identify the three drain designs that have been installed in Ontario.

4.12 Identify the most common drain design system currently installed.

4.13 Explain why combined drainage systems have been prohibited.

4.14 Describe the steps required to convert a semi-combined system into a separate drainage system.

Number:	S00027.5	
Title:	**Datum Line and Instrument Readings**	
Duration:	Total Hours:	6
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00021, S00024	
Co-requisites:	S00028, S00029, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464 U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify, define, and apply datum line and instrument principles in practical applications.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

5.1 Define the following terms:
- "zero datum"
- "leveling"
- "elevation"
- "bench mark"
- "assumed level"
- "backsight"
- "foresight"
- "turning points"
- "builders level"
- "transit level"
- "meter rod"
- "total station"

5.2 Identify elevation readings from a plot plan.

5.3 Convert instrument readings (given in feet and decimals of a foot) to feet, inches, and sixteenths of an inch.

5.4 Convert measurements (given in feet, inches, and fractions of an inch) to feet and tenths of a foot.

5.5 Calculate the total fall on a drain when given two points from an instrument reading.

5.6 Calculate the length of a drainage pipe when the total fall and grade are given on an elevation or plan view drawing.

5.7 Calculate the grade of a drainage pipe when the total fall and length are given on an elevation or plan view drawing.

5.8 Calculate the depth of a drain using both metric measurement (meters and millimeters) and imperial measurement (feet, inches, and fractions of an inch) from a given datum on a plan.

5.9 Demonstrate the ability to set-up and operate measuring equipment to obtain and record backsight, foresight, turning point, benchmark, and elevation data.

WASTE PIPE SYSTEMS:

Number:	S00027.6	
Title:	**Commercial Sanitary Drain System Sizing**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to size all sections of the sanitary drainage system on drain plans, stack elevations, and practical assignments for multi-dwelling and commercial structures.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

6.1 Identify and use tables to:
- calculate fixture unit loading
- size horizontal and vertical drainage piping
- convert fixture units to litres per minute flow
- convert litres per minute to fixture units

6.2 Identify the restrictions when connecting water closets to drainage piping.

6.3 State the minimum allowable fall on drainage piping.

6.4 Explain how grade affects the capacity of a given horizontal drainage pipe.

6.5 Explain the effect of flow rates and velocity on the efficiency of the drainage system.

Number:	S00027.7	
Title:	**Grease Interceptors**	
Duration:	Total Hours:	5
	Theory:	5
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022, S00024	
Co-requisites:	S00027, S00029, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define, identify size, and describe the installation requirements for grease interceptors.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

7.1 Define the term, "interceptor".

7.2 State the purpose of a grease interceptor.

7.3 State the principle that enables grease to be separated from water.

7.4 List the conditions that are eliminated when a grease interceptor is installed.

7.5 Identify and list the different locations a grease interceptor shall be installed.

7.6 Identify and apply the sizing requirements for a grease interceptor.

7.7 Explain why a grease interceptor may no longer act as a fixture trap.

7.8 Identify the fixtures that may discharge into a grease interceptor.

7.9 Identify the fixtures that may not discharge into a grease interceptor.

7.10 State the installation requirements for grease interceptors.

7.11 Define an electronic grease interceptor.

7.12 Explain the difference between an electronic and a standard grease interceptor.

7.13 Identify the locations for cleanouts on a grease interceptor installation.

7.14 State the purpose of the vent piping that must be installed in a grease interceptor installation.

7.15 Specify the vents required for a manufactured grease interceptor.

7.16 Explain the purpose and location of both the flow control fitting and the secondary flow control fitting serving grease interceptors.

Number:	S00027.8	
Title:	**Oil Interceptors**	
Duration:	Total Hours:	5
	Theory:	5
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00021, S00022	
Co-requisites:	S00027	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define, identify, and describe the installation requirements for an oil interceptor.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

8.1 State the purpose of an oil interceptor.

8.2 State the principle that enables oil to be separated from water.

8.3 State the installation requirements for oil interceptors.

8.4 List hazardous conditions that are eliminated when an oil interceptor is installed.

8.5 List locations that require the installation of an oil interceptor.

8.6 Identify two approved types of oil interceptors.

8.7 State the installation requirements for built-in place oil interceptors.

8.8 State the purpose of the vent piping that must be connected to oil interceptors.

8.9 Specify the vents required for a manufactured oil interceptor.

8.10 Specify the location of the vent terminals required for oil interceptor vent pipes.

8.11 State the minimum vent terminal heights required for an oil interceptor vent piping.

8.12 Identify the locations for cleanout installations.

8.13 Explain the purpose of the flow control fitting on the inlet of an oil interceptor.

8.14 Explain the operating principle of an internal gravity draw-off fitting.

8.15 State the proper setting for an adjustable gravity draw-off fitting.

8.16 Define an electronic oil interceptor.

8.17 Define the term, "oil holding tank / secondary receiver".

8.18 Explain the difference between an electronic and a standard oil interceptor.

8.19 Explain how an oil holding tank is installed in conjunction with an oil interceptor, and the function of the primary and secondary chambers found in built-in place oil interceptors.

8.20 State the installation location of an oil interceptor in relation to floor and trench drains.

8.21 Identify the requirements for gang trapping fixtures discharging into an oil interceptor.

Number:	S00027.9	
Title:	**Sediment Interceptors**	
Duration:	Total Hours:	2
	Theory:	2
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define, identify, and describe the installation requirements for various sediment interceptors, including sand and grit, plaster, hair, fish scale, food scrap, and precious metal interceptors.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

9.1 State the purpose of a sediment interceptor, and the principle that enables sediment to be separated from water.

9.2 List the conditions that are eliminated when a sediment interceptor is installed.

9.3 List locations and buildings that may require the installation of sediment interceptors.

9.4 Identify the different locations where sediment interceptors may be installed.

9.5 Explain when a sediment interceptor may or may not act as a fixture trap.

9.6 Identify the fixtures that should discharge into a sediment interceptor.

9.7 State the installation requirements for sediment interceptors.

9.8 Identify the locations for cleanouts on a sediment interceptor installation.

Number:	S00027.10	
Title:	**Blow Down and Blow Off Tanks**	
Duration:	Total Hours:	2
	Theory:	2
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define, identify, and describe the installation requirements for blow down tank installations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

10.1 Define the trade term "blow down," and "blow off tank".

10.2 State the purpose of a blow down and blow off tanks.

10.3 State the materials used in the construction of a blow down and blow off tanks.

10.4 State the working pressures for steel and cast iron blow down and blow off tanks.

10.5 List the connections a plumber may be responsible for when installing blow down and blow off tanks.

10.6 Describe the acceptable methods used to supply cold water to blow down and blow off tanks.

10.7 Explain the purpose of an anti-siphon pipe when installed for blow down and blow off tanks.

10.8 Explain the vent terminal requirements for blow down tank installation.

10.9 Explain the vapour vent requirements for blow off tank installation.

Number:	S00027.11	
Title:	**Ejectors and Sumps**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00021, S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to define, identify, and describe the installation requirements for sewage ejectors and storm sump installations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

11.1 Define the terms, "sewage ejector" and "storm sump".

11.2 Identify the installation requirements for sewage ejectors and storm sumps.

11.3 List the main requirements of equipment selection.

11.4 State the maximum time sewage may be held in a sewage tank.

11.5 Explain the purpose of and position where a union, check, and shut-off valve must be installed in an ejector and sump discharge pipe.

11.6 State where a sewage ejector discharge pipe may connect to the sanitary system.

11.7 State where a storm sump discharge pipe may connect to the storm system.

11.8 Describe the method of sizing a building drainage system when a sewage ejector is installed.

11.9 Explain the meaning of the term, "high water alarm".

11.10 State the different ways the operation of a sewage ejector and storm sump may be controlled.

11.11 State the requirements for a sewage ejector vent.

11.12 Discuss the requirements for venting sealed storm sumps.

11.13 Describe the difference between a sewage pump and storm water pump.

11.14 State the installation requirements of a sewage ejector pit and pump installation.

11.15 State the installation requirements of a storm water pit and pump installation.

VENTING SYSTEMS:

Number:	S00027.12	
Title:	**Branch Vents**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to apply branch venting in multi-dwelling and commercial structures.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

12.1 Identify and apply the tables used to size branch vents in multi-dwelling and commercial structures.

Number:	S00027.13	
Title:	**Wet Venting**	
Duration:	Total Hours:	6
	Theory:	6
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to apply wet venting in multi-dwelling and commercial structures.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

13.1 Identify and apply the codes and tables used to size wet vents in multi-dwelling and commercial structures.

Number:	S00027.14	
Title:	**Vent Stacks**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, describe, size, and install drain waste and vent installations that utilize a vent stack.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

14.1 Define the term, “vent stack”.

14.2 Explain the difference between the terms, “vent stack” and “stack vent”.

14.3 Explain the purpose of a vent stack.

14.4 State where the installation of a vent stack is required.

14.5 Determine the minimum size of a vent stack.

14.6 Explain the different initial connection points of a vent stack.

14.7 Identify and use the tables used to determine vent stack size.

14.8 Indicate how to size a vent stack from its initial connection point to its final termination point.

14.9 Identify the type and number and location of fixtures that may connect to a vent stack.

14.10 Identify the lowest point on a vent stack where other vents may connect.

Number:	S00027.15	
Title:	**Circuit Venting**	
Duration:	Total Hours:	9
	Theory:	9
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, describe, size, and install drain waste and vent installations that utilize circuit venting.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

15.1 Define the term, "circuit vent" and "additional circuit vent".

15.2 State the principle used in circuit venting.

15.3 Explain the primary purpose of circuit venting.

15.4 Identify the types of buildings where circuit vents are commonly installed.

15.5 Explain where a circuit vented branch may connect to a drainage system.

15.6 Specify the maximum length and fall of a circuit vented fixture drain serving a p-trap fixture, and siphonic fixtures.

15.7 Describe the effect of excessive fall in a circuit vented fixture drain serving a p-trap fixture.

15.8 Specify the number and location of circuit vents required, given the number of fixtures connected to a horizontal branch.

15.9 State the minimum size of a circuit vent.

15.10 Describe how to size a circuit vent and additional circuit vent.

15.11 State the purpose of a relief vent.

15.12 Explain the installation location and minimum size of a relief vent.

15.13 State the purpose of a combined relief vent and explain where it may be installed.

15.14 State the number and types of fixtures that may connect to a circuit vented branch.

15.15 State the number and type of fixtures that may connect to circuit vent.

15.16 State the number and type of fixtures that may connect to a relief vent.

Number: S00027.16

Title: Yoke Vents, Auxiliary Stacks, and Offset Relief Vents

Duration: Total Hours: 3

Theory: 3
Individual/Group Work: 0
Out of Class Practical: 0

Prerequisites: S00022

Co-requisites: S00027, S00028, S00030

Cross Reference to Training Standards: U5457 U5458 U5459 U5460 U5461 U5462

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, describe, size and install drain waste and vent installations that utilize yoke venting.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

16.1 Define the term, "yoke vent", and state the purpose of yoke venting.

16.2 Identify the type of buildings in which yoke venting would be installed.

16.3 State the number of floor levels that comprise a section for the purpose of yoke venting.

16.4 Explain the difference in the definitions of "storey" listed in Part 1 of the OBC and Part 7 of the OBC.

16.5 Identify the point at which a yoke vent may connect to a soil or waste stack.

16.6 Identify the point where a yoke vent must connect to a vent stack.

16.7 Determine the number of yoke vents required for an installation given the number of storeys.

16.8 Define the trade term, "auxiliary stacks".

16.9 State the application of an auxiliary stack.

16.10 State the reason why plumbing should not connect to the lower section of high stacks.

16.11 Explain the spacing of yoke vents.

16.12 Determine the minimum size of a yoke vent.

16.13 State the number and type of fixtures that may connect to a yoke vent.

16.14 Define a "stack offset" and "double offset".

16.15 Determine the size of a given stack offset.

16.16 Determine the location of fixture connections to a stack offset.

16.17 Explain the difference between a nominally horizontal and a nominally vertical stack offset.

16.18 Describe the installation requirements that eliminate the requirement for yoke vents.

16.19 Define the term, "offset relief vent".

16.20 State the application of an offset relief vents.

16.21 Determine the minimum size of an offset relief vent.

WATER DISTRIBUTION SYSTEMS:

Number:	S00027.17	
Title:	**Types of Valves**	
Duration:	Total Hours:	4
	Theory:	4
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize various valves.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

17.1 State the primary purpose of a valve.

17.2 Describe the different ways a valve may control flow.

17.3 Describe the four principle valve types.

17.4 Identify the materials used for valve manufacture and which may be installed in a plumbing system.

17.5 Identify and list the major component parts of the following valves, including:
- gate valves
- plug valves
- ball valves
- globe valves
- check valves
- butterfly valves

17.6 Identify the common types of gate valves and list their uses, including:
- solid wedge disc
- split wedge disc
- double disc
- plug disc
- resilient seated gate valve

17.7 Identify the common type of globe valves and list their uses, including:
- conventional disc
- composition disc
- plug disc
- needle valves

17.8 Identify the common types of ball valves and list their uses, including:
- end- port, or blow out proof ball valves
- top port
- in-line
- full port
- standard port ball valves

17.9 Identify the common types of check valves and list their uses, including:
- swing check valves
- lift check valves
- non-slam check valves
- spring loaded check valves

17.10 Identify the common uses of butterfly valves.

17.11 Identify the common uses of plug valves in a plumbing system.

17.12 Describe the stem operations of:
- rising stem with inside screw
- rising stem with outside screw
- non-rising stem with inside screw
- outside stem and yoke

17.13 Describe the design and function of:
- screwed bonnet assembly
- union bonnet assembly
- bolted bonnet assembly
- clamp-type bonnet assembly

17.14 Describe the function and design of:
- packing nut with gland
- bolted gland
- lantern type gland

17.15 Identify the different methods of controlling valves, including:
- handles
- levers
- lever handles
- timers
- limit torque arresters
- solenoid switches
- chains on wheels
- spring loaded activators
- electronic sensors
- motorized actuators

17.16 Describe the recommended installation locations and procedures for all types of valves.

17.17 Identify valve abbreviations, including:
- SS
- FM
- UL
- IBBM
- RS
- NRS
- WOG
- WSP
- CSA
- AWWA
- CGA
- AGA

17.18 Explain basic valve service requirements for:

- gate valves
- globe valves
- check valves
- ball valves

17.19 List the factors to be considered when selecting a valve for a specific purpose.

17.20 Explain the meaning of pressure ratings and lettering found on valve bodies.

17.19 List the common end connections found on valve bodies.

Number:	S00027.18	
Title:	**Location of Valves**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the installation location of control valves in potable water distribution systems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

18.1 Identify the type of valve installed on the water service pipe outside the building.

18.2 Identify the location of the control valve, installed on the water service pipe

18.3 outside the building, and state its minimum size.

18.4 Define the term, "building control valve".

18.5 Identify the requirements for and the type of building control valves commonly installed on water services ¾" and 1" in diameter.

18.6 State the building control valve and drain valve requirements for water services larger than 1" in diameter.

18.7 Explain why a check valve must be installed at the end of a plastic water service that may be damaged by hot water and discuss the resulting effects of thermal expansion.

18.8 Identify where a shut-off valve must be installed in a hot water tank installation.

18.9 Explain the types of valves that may be installed to supply water to the exterior of a building.

18.10 State the types of shut-off valves that must be installed to isolate the supply water to the exterior of a building.

18.11 Identify the fixtures, appliances, tanks, and devices that must be equipped with a shut-off valve.

18.12 Identify where shut-off valves must be installed to supply a riser in a non-residential building.

18.13 Identify where shut-off valves must be installed to control the flow of water to suites in a building.

18.14 Identify where shut-off valves must installed to control the flow of water to fixtures installed in public washrooms.

18.15 Identify the type and installation sequence of the valves required on the discharge piping from a sewage ejector.

18.16 Identify the type of valves that must be sold, assembled, and shipped with backflow prevention devices.

18.17 Identify the types of valves associated with flushometers.

Number:	S00027.19	
Title:	**Water Distribution Terms and Definitions**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify and explain water distribution terms and definition.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

19.1 Identify and state the code section of the OBC that lists water distribution terms and definitions and contains abbreviations of proper names.

19.2 Define the following terms, identifying minimum pipe size, installation, or system location, as well as other distinguishing characteristics:

- "water purveyor"
- "water distribution system"
- "water service pipe"
- "water system"
- "distribution pipe"
- "fire service main"
- "potable"
- "risers"
- "mains"
- "recirculation"

Number:	S00027.20	
Title:	**Hot Water Tanks**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain domestic hot water tank installations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

20.1 Define the term, "domestic", when applied to hot water tanks.

20.2 State four uses for domestic hot water heaters.

20.3 State the working and test pressures for a domestic hot water storage tanks.

20.4 State two reasons for installing a shut-off valve on the cold water supply to a tank.

20.5 Explain why the cold-water inlet must be located near the bottom of the tank or must be delivered to the bottom of the tank using a "dip tube".

20.6 Name the materials that are commonly used as a protective coating on the inside of the tank wall.

20.7 Define the term, “sacrificial anode”.

20.8 Explain control of “legiononella bacteria”.

20.9 Identify the sources of heat commonly used on domestic hot water tanks.

20.10 State the advantages and disadvantages of electric, gas-fired, oil-fired, and solar hot water tanks.

20.11 Identify the installation requirements pertaining to domestic hot water tanks.

20.12 Complete a detailed drawing of a domestic hot water tank installation showing up to 15 correctly located items.

Number: S00027.21

Title: Hot Water Thermostatic Mixing Valves

Duration: Total Hours: 2

Theory: 2
Individual/Group Work: 0
Out of Class Practical: 0

Prerequisites: S00022

Co-requisites: S00027, S00028, S00030

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the installation requirements of thermostatic mixing valves.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

21.1 State the purpose of a thermostatic mixing valve.

21.2 Identify different types of thermostatic mixing valves.

21.3 State the discharge temperature for a master thermostatic mixing valve installed on a domestic hot water system.

21.4 Identify the maximum water discharge temperature for fixture supplies.

21.5 Describe the locations for the different types of thermostatic mixing valves.

21.6 Identify the working parts of a thermostatic mixing valve.

Number:	S00027.22	
Title:	**Temperature and Pressure Relief Valves**	
Duration:	Total Hours:	2
	Theory:	2
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain the installation requirements of temperature and pressure relief valves.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

22.1 State the purpose of a temperature and pressure relief valve.

22.2 Explain the possible results of a hot water tank malfunctioning without a temperature and pressure relief valve installed.

22.3 State the discharge temperature and pressure settings for a temperature and pressure relief valve installed for a domestic hot water tank.

22.4 Describe the location of the sensing element for a temperature and pressure relief valve.

22.5 State the location a temperature and pressure relief valve may be installed.

22.6 State the location where a temperature and pressure relief valve drain may discharge.

22.7 State the diameter and the acceptable materials of the discharge pipe of a temperature and pressure relief valve.

22.8 Identify the working parts of a temperature and pressure relief valve.

22.9 State the boiling point of water at atmospheric pressure.

22.10 State the boiling point of water under a pressure of 50 and 100 PSIG.

22.11 Explain the meaning of thermal heat lag in relation to the boiling point of water.

22.12 Determine water temperature when a temperature and pressure relief valve is installed at a given height above a hot water tank with a given pipe diameter.

Number:	S00027.23	
Title:	**Water Meters**	
Duration:	Total Hours:	6
	Theory:	4
	Individual/Group Work:	0
	Out of Class Practical:	2
Prerequisites:	S00022	
Co-requisites:	S00021, S00022, S00024	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain water meter and water meter by-pass installations and operations of all sizes.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

23.1 Describe the functions of a water meter.

23.2 Describe the operation of a water meter.

23.3 Identify alternate applications of water meters.

23.4 Identify the unit of measure used to measure water consumption.

23.5 Identify when authorities govern the installation of water meters.

23.6 Name the three standard types of water meters.

23.7 Explain how water meters are protected when installed in areas that may be subject to freezing conditions.

23.8 Identify the water meters installed to register and record small, large, and both small and large water flows.

23.9 Identify the registers used on water meters.

23.10 Explain how remote registers operate and how they are read.

23.11 Explain the purpose of a meter by-pass.

23.12 Describe the two basic by-pass designs.

23.13 State the number of shut-off valves installed for a by-pass installation.

23.14 Identify the types of valves that may be installed in a water meter by-pass.

23.15 Explain the characteristics of valves installed in a water meter by-pass.

23.16 Draw single-line isometric sketches illustrating the design and installation of water meters and water meter by-passes.

PLUMBING FIXTURES, APPLIANCES AND EQUIPMENT:

Number:	S00027.24	
Title:	**Plumbing Fixtures**	
Duration:	Total Hours:	10
	Theory:	8
	Individual/Group Work:	0
	Out of Class Practical:	2
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, explain, and install a number of plumbing fixtures.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

WATER CLOSETS:

24.1 Describe the operation and list the materials used in the manufacture of a water closet.

24.2 Identify the association that must approve both the water closet bowl and the components installed in the water closet tank.

24.3 Discuss the features of a well-designed water closet.

24.4 Identify various water closet installations.

24.5 Identify the type of bowl design from a given cross-sectional diagram:
- blowout type bowl
- reverse trap bowl
- siphon jet bowl
- wash-down bowl
- macerating toilet

24.6 Identify the type of bowl and seat that must be installed in a washroom intended for public use.

24.7 Explain the term, "barrier-free", when used in conjunction with plumbing fixtures.

24.8 Explain the difference between a barrier-free and a regular water closet bowl.

URINALS:

24.9 Describe the operation of a urinal and list the materials used in the manufacture of urinals.

24.10

24.11 Identify the type of urinals from a given cross-sectional diagram, including:
- stall urinal
- wall-hung urinal with (a) integral trap (b) integral siphonic trap (c)separate trap

24.11 Explain the effects of waterless urinals.

BIDET:

24.12 Describe the operation of a bidet, and list the materials used in the manufacture of a bidet.

24.13 Identify the type of bidet from a given cross-sectional diagram, including:
- submerged supply
- deck-mounted faucet

24.14 Explain the type of cross-connection created with the installation of a bidet equipped with a submerged supply.

24.15 Identify the type of backflow prevention device that must be supplied with submerged head bidets.

BATHTUBS:

24.16 Describe the operation of a bathtub, and list the materials used in their manufacture.

24.17 Explain the difference between a left-hand bathtub and a right-hand bathtub.

24.18 Describe the principle of operation of a whirlpool bathtub and a hydro-massage tub.

SHOWERS:

24.19 Describe the operation of a shower and list the materials used in their manufacture.

24.20 Identify the different types of showers that may be installed, including:

- public shower area
- spa shower
- built-on-site shower
- built-on-site shower installed with a manufactured shower base
- manufactured shower cabinet/enclosures
- manufactured neo-corner shower base with installed glass enclosures

24.21 Define the terms, "shower pan liner" or "shower safe", and explain the purpose of its installation and the type of shower drain assembly that must be installed.

24.22 State the number of shower valves that may be served by a single shower drain.

24.23 Explain how and why the floor must be sloped in a group shower installation.

24.24 State the minimum horizontal distance allowed between showerheads.

24.25 State the minimum trap size that may be installed to serve a showerhead.

Explain the construction and installation requirements of a barrier-free shower installation.

LAVATORIES:

24.27 Describe the operation of a lavatory and identify the materials used in the manufacture of lavatories.

24.28 Identify the basic lavatory types, including:

- wall-hung
- pedestal-mounted
- vanity top

24.29 Identify the different faucet spacing options available for lavatories.

24.30 Describe the type of waste fitting that must be installed when a lavatory is not equipped with an overflow.

24.31 Explain the construction and installation requirements of a barrier-free lavatory installation.

SINKS:

24.32 Describe the operation of a kitchen sink and identify the materials used in their manufacture.

24.33 Identify the options available for kitchen sinks, including:

- number of compartments
- ledge back
- number of openings in the ledge back
- under-counter installation
- corner installation
-

24.34 List and identify sink requirements as they apply to all food premises.

24.35 Explain why a food preparation or a dishwashing sink may not be equipped with a concealed overflow.

24.36 Describe the operation of a service sink and list the materials used in their manufacture.

24.37 Identify various types of service sinks, including wall-hung, floor-mounted and recessed.

24.38 Explain what measures are taken to prevent a possible backflow condition at a service sink.

24.39 Explain the difference between a P-trap standard and an S-trap standard used in conjunction with a wall-hung service sink installation.

DRINKING FOUNTAINS:

24. 40 Describe the operation of drinking fountains and identify the materials that are used in their manufacture.

24. 41 Explain why the bubbler of a drinking fountain must be shielded and why the water from it must be directed up, at approximately 45 degrees.

24. 42 Explain the purpose of the installation of a refrigeration unit in a drinking fountain.

24. 43 Identify, from a number of illustrations, common types of drinking fountains, including:

- free-standing refrigerated drinking fountains
- wall-mounted drinking fountains
- barrier-free drinking fountains

Number: S00027.25

Title: Faucets and Shower Control Valves

Duration: Total Hours: 3

Theory: 3
Individual/Group Work: 0
Out of Class Practical: 0

Prerequisites: S00022

Co-requisites: S00027, S00028, S00030

Cross Reference to Training Standards: U5457, U5458, U5459, U5461, U5462

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, explain, assemble, and install a number of faucets.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

25.1 Describe the operation of faucets, and identify materials used in their manufacture.

25. 2 State the association that must approve all supply fittings.

25. 3 Identify the following faucets and control valves including:

- tub
- shower
- lavatory
- residential sink
- commercial sink
- electronic

- laundry tub
- service sink

25. 4 State the type of control valves that must be installed for showers.

25. 5 Describe the difference between a pressure balanced and a thermostatic mixing control valve.

25. 6 State the maximum allowable length of a flexible supply tube.

25. 7 State the maximum allowable flow rates from various faucets and control valves.

25. 8 Identify which side of a faucet and control valves must control the hot water supply and which side must control the cold water supply.

Number:	S00027.26	
Title:	**Water Closets, Urinals, Flush Tanks, and Flushometers**	
Duration:	Total Hours:	6
	Theory:	4
	Individual/Group Work:	0
	Out of Class Practical:	2
Prerequisites:	S00022	
Co-requisites:	S00027, S00028	
Cross Reference to Training Standards:	U5457 U5458 U5459 U5460 U5461 U5462 U5463 U5464 U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, explain, install, and perform routine service on water closet and urinal flushometers.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

26.1 Describe the function of a water closet flush tank and urinal flush tank.

26.2 Identify the different types of flush tanks.

26.3 State the capacities of water closet tanks.

26.4 Explain the operation of a water closet flush valve.

26.5 Identify the major components of a water closet flush tank.

26.6 Explain how to adjust the water level and refill time of a water closet flush tank.

26.7 Explain the purpose of a urinal flush tank and alternate uses of urinal flush tanks.

26.8 Explain the operation of a urinal flush valve.

26.9 State the volume of a urinal flush tank.

26.10 Identify the major components of urinal flush tanks.

26.11 Explain how to adjust the water level and adjust the refill time of a urinal flush tank.

26.12 Explain the requirements that control unnecessary flush cycles of urinal flush tanks during building-down time.

26.13 Describe the function of a diaphragm-type flushometer valve.

26.14 Explain why the diaphragm-type flushometers are considered superior to the piston slip seal-type flush valve.

26.15 Explain the differences between a water closet and a urinal flushometer.

26.16 Describe the function and installation location of the vacuum breaker supplied with water closet and urinal flushometers.

26.17 State the maximum number of litres a water closet and urinal flushometer may discharge.

26.18 Explain why a control valve is installed with both water closet and urinal flushometers.

26.19 Explain the operation of various manufacturers' flushometers.

26.20 Describe how to adjust the flush cycle of a flushometer.

26.21 State where an electronic flushometer may be installed.

26.22 Describe the alterations that were made to standard flushometers to have them operate electronically.

26.23 Explain the principle of operation of an electronic flushometer valve.

26.24 Explain the different types of power supplies that may be used to operate electronic flushometer valves.

26.25 Describe the adjustments that may be made to electronic flushometer valves.

26.26 Identify the cause and explain the solution of flushometer operating problems.

CODES:

Number:	S00027.27	
Title:	**Testing Requirements**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028	
Cross Reference to Training Standards:	U5457 U5458 U5459 U5460 U5461 U5462 U5463 U5464 U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, perform, and comply with testing requirements.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

DRAINAGE:

27.1 Explain the purpose of testing plumbing systems.

27.2 Identify the code sections, listed in Part 7, that deal with testing of the drainage system, venting system, and storm systems.

27.3 Identify the tests that the sanitary and storm drainage system must be capable of withstanding without leakage, including:

- water tests
- air tests
- ball tests
- final tests

27.4 Identify the tests that the venting system must be capable of withstanding without leakage, including:

- water tests
- air tests
- final tests

27. 5 State the purpose of water testing the DWV and storm drainage system, and explain how to prepare them for a water test.

27. 6 Identify the tools and equipment required to perform a water test on the DWV and/or storm drainage system.

27. 7 Explain how a water test may be applied to the entire DWV and/or storm drainage system or to sections of the DWV and/or storm drainage system.

27. 8 Identify the minimum height a water test may be applied to a DWV and/or storm drainage system.

27. 9 Explain the purpose of the installation of a test fitting(s) in the DWV and/or storm drainage system.

27. 10 Identify where test fittings are installed in a DWV and/or storm drainage system.

27. 11 State the maximum recommended height of a water test when the drainage system has been constructed, using mechanical joint couplings and cast iron soil pipe and fittings.

27. 12 State the minimum time a water test must be maintained on a DWV and/or storm drainage system.

27. 13 State the purpose of air testing the DWV and/or storm drainage system, and explain why an air test would be performed instead of a water test.

27. 14 Identify the tools and equipment required to perform an air test on a DWV and/or storm drainage system, and explain how to prepare them for the test.

27. 15 Explain how an air test may be applied to the entire DWV and/or storm drainage system or sections of the DWV and/or storm drainage system.

27. 16 Identify the minimum section height of the DWV and/or storm drainage system to which an air test may be applied.

27. 17 State the minimum allowable air pressure for an air test when testing the DWV and/or storm drainage system.

27. 18 State the minimum time an air test must be sustained when testing the DWV and/or storm drainage system.

27. 19 Explain the different methods that may be used to find a leak in a DWV and/or storm drainage system when testing with air.

27. 20 Define the term, "ball test", and explain its purpose.

27. 21 Identify the sections of the DWV and/or storm drainage system where a ball test shall be performed.

27. 22 State the specific gravity and diameter of the ball used in a ball test, and explain how to perform a ball test.

27. 23 Define the term, "final test/smoke test", and explain the purpose of conducting this test.

27. 24 Identify the municipal official who determines if a final test is required.

27. 25 Identify the tools and equipment required to perform a final test.

27. 26 Explain how to prepare the DWV system for a final test.

27. 27 State the air pressure that must be maintained when performing a final test on the DWV system.

27. 28 State the minimum time a final test must be sustained on the DWV system.

27. 29 Define the term, "cross-connection test /dye test", and explain the purpose of conducting it.

POTABLE:

27. 30 Identify the tests that the potable water system must be capable of withstanding, without leakage, including:

- water tests
- air tests

27.31 State the purpose of water or air testing the potable water system.

27.32 Identify the tools and equipment required to perform a water or air test on the potable water system.

27.33 Explain how to prepare the potable water system for a water or air test.

27.34 State the minimum water pressure and time that must be sustained when performing a water test on the potable water system.

27.35 Explain when the potable water system must be tested, as a complete system or in sections.

27.36 State the type of water that must be used when water testing a potable water system.

27.37 State the minimum allowable air pressure and time that must be sustained when performing an air test on the potable water system.

Number:	S00027.28	
Title:	**Required Inspections**	
Duration:	Total Hours:	1
	Theory:	1
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5462, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and arrange all required inspections.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

28.1 Explain the purpose of a plumbing inspection.

28.2 Identify the information required by a municipal inspector when requesting an inspection.

28.3 Identify who may conduct inspections, including:
- municipal building officials
- fire department officials
- inspectors representing the owner of a building
- health inspectors

28.4 Identify sections of documents that outline the required inspections for various piping systems, including:
- job specifications
- NFPA standards for standpipe and sprinkler
- CAN/CSA-B149.1-05
- CSA medical gas installation standard
- Ontario Building Code (OBC).

28.5 Identify when the DWV system requires inspections.

28.6 Explain the inspection process if a piping system is prefabricated off the building site.

28.7 Explain when the potable water system requires inspections.

28.8 Explain when the plumbing system requires a final test and/or inspection.

28.9 Identify the key points to be examined during inspections of a DWV, storm piping systems, and potable water systems.

28.10 Explain what steps an inspector must take when a system(s) or component does not conform to the OBC.

28.11 Explain what steps a plumber must take to comply with an inspector's orders.

PROPER
ES OF WATER AND HEAT TRANSFER:

Number:	S00027.29	
Title:	**Heat Transfer**	
Duration:	Total Hours:	2
	Theory:	2
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027	
Cross Reference to Training Standards:	U5457 U5458 U5459 U5460 U5461 U5463 U5464 U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify, define, and state the practical applications of heat transfer.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

29.1 Define the term, "heat transfer".

29.2 Identify the three main methods of heat transfer.

29.3 Explain the following heat transfer processes, including:
- conduction
- convection
- radiation

29.4 Identify three good conductors of heat.

29.5 Identify three poor conductors of heat.

29.6 Explain thermal conductivity.

29.7 Identify three factors that may affect the speed that an iron bar will conduct heat.

29.8 Identify and list two examples of forced convection.

29.9 Identify the type of materials that will readily absorb radiant heat.

29.10 State the approximate percentage of radiated heat emitted by a cast iron radiator.

Number:	S00027.30	
Title:	**Latent and Sensible Heat**	
Duration:	Total Hours:	2
	Theory:	2
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify and interpret the definitions and principles of latent heat.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

30.1 Define the terms:
- "heat"
- "latent heat"
- "sensible heat"
- "heat intensity"
- "heat quantity"

30.2 Explain the difference between heat intensity and heat quantity.

30.3 Explain what happens when the temperature of a substance decreases.

30.4 Describe the type of unit used to measure latent heat.

30.5 Explain why latent heat is often described as "hidden heat".

30.6 Explain the purpose of calculating latent heat.

30.7 State the value of the latent heat of fusion for water.

30.8 Describe the method of measuring latent and sensible heat.

30.9 State the value of the latent heat of vaporization.

30.10 Describe the method of measuring the latent heat of vaporization for water at atmospheric pressure.

30.11 Complete a number of assignments that require the calculation of the latent heat of fusion and the latent heat of vaporization.

Number:	S00027.31	
Title:	**British Thermal Units**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify, define, and perform calculations involving British Thermal Units.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

31.1 Define the term, "British Thermal Unit", and the abbreviation, "MBTU"

31.2 Explain when MBTU would be used.

31.3 Define the term, "specific heat".

31.4 State the formula used to calculate the specific heat of a substance when the heat quantity, mass, and temperature change is known.

31.5 State the specific heat of:

- water
- ice
- air
- steam
- lead

31.6 State the formula for calculating heat quantity when mass, temperature change, and the specific heat of a substance are known.

31.7 Explain the law of heat exchange.

31.8 Calculate the quantity of heat gained or lost when the mass, temperature change, and specific heat of a substance are known.

31.9 Calculate the quantity of heat gained or lost by a substance undergoing a change of state when mass, temperature change, specific heat, and the latent heat are known.

Number:	S00027.32	
Title:	**Properties of Water**	
Duration:	Total Hours:	2
	Theory:	2
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00022	
Co-requisites:	S00027	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to identify, define, and explain the properties of water.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

32.1 Explain the term, "potable water".

32.2 State the chemical composition of water, and list and explain its chemical symbol, H^2O.

32.3 Describe the characteristics of pure water.

32.4 Identify the different states of water.

32.5 Define water in a solid state and a gaseous state.

32.6 State the density of water.

32.7 State the formula used to find the specific gravity of a substance.

32.8 State the specific gravity of:

- water
- ice
- steam
- mercury
- lead

32.9 State the approximate expansion of water when converted to steam at 212° Fahrenheit or 100° Celsius.

32.10 State the approximate expansion of water when converted to ice at 32° Fahrenheit or 0° Celsius.

32.11 Calculate the boiling point of water in Fahrenheit at 50, 100, and 150 PSIG.

32.12 Calculate the boiling point of water in Fahrenheit when it is confined in a vacuum.

32.13 State the boiling point and freezing point of water on the Celsius and Fahrenheit scales.

32.14 State the terms used at 0°, 4°, and 100° on the Celsius scale.

32.15 State the terms used at 32°, 39.2°, and 212° on the Fahrenheit scale.

Number: S00028.0

Title: **DWV PIPING SYSTEMS**

Duration: 48 Total Hours

Theory: 0 Practical: 48

Prerequisites: S00021, S00022

Co-requisites: S00027, S00028, S00030

Evaluation Structure

Theory Testing	20%
Application Exercises	70%
Final Assessment	10%

Number: S00028.1

Title: **Design, Draw, Install, and Test Various Drain, Waste, Vent, Storm, and Fixture Installations**

Duration: Total Hours: 42

Theory: 0
Individual/Group Work: 0
Out of Class Practical: 42

Prerequisites: S00022

Co-requisites: S00027, S00028, S00030

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL L ARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to plan, design, draw, install, test, and commission a four-piece fixture installation.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

1.1 Plan the layout of a four-piece washroom group.

1.2 Plan for the use and installation of:
- plastic pipe
- copper pipe
- cast iron pipe

1.3 Design the DWV and potable water system for the installation of the washroom group.

1.4 Prepare a set of working drawings, including:
- plan view
- stack elevation
- complete material list
- isometric DWV drawings
- isometric water pipe drawing

1.5 Prepare a set of shop drawings for the fixtures, faucets, and components to be installed.

1.6 Submit drawing package and shop drawings for review, alterations, and approval.

1.7 Install the DWV and the hot and cold potable water pipe systems.

1.8 Water and air test the DWV piping.

1.9 Test the potable water system.

1.10 Assemble and install the fixtures and fixture trim, including at least one wall-mounted fixture.

1.11 Set up and perform a final air test on the completed installation.

Number:	S00028.2	
Title:	**Perform Various Service, Maintenance, and Repair Assignments**	
Duration:	Total Hours:	6
	Theory:	0
	Individual/Group Work:	0
	Out of Class Practical:	6
Prerequisites:	S00021, S00022	
Co-requisites:	S00027, S00028	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to perform various service operations suited to particular geographical locations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

2.1 Troubleshoot, shutdown, dismantle, rebuild, reassemble, and reactivate a variety of water closet and urinal flushometers.

2.2 Troubleshoot, shutdown, dismantle, rebuild, reassemble, reactivate, and set-up a variety of electronic lavatory faucets, water closet, and urinal flushometers.

2.3 Perform a series of tests to determine if a domestic electric hot water is performing correctly.

2.4 Troubleshoot, shutdown, remove, disassemble, rebuild, reinstall, and set-up a simplex and/or duplex storm/sewage pump installation.

Number:	S00029.0
Title:	**TRADE CALCULATIONS – LEVEL 2**
Duration:	24 Total Hours
	Theory: 24 Practical: 0
Prerequisites:	S00024
Co-requisites:	S00027, S00028, S00029, S00030

Evaluation Structure

Theory Testing	80%
Application Exercises	0%
Final Assessment	20%

Number:	S00029.1	
Title:	**Area Calculations**	
Duration:	Total Hours:	6
	Theory:	6
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00024	
Co-requisites:	S00027, S00028, S00029, S00030	
Cross Reference to Training Standards:	U5458, U5459, U5461, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to calculate the area of geometric shapes including squares, rectangles, circles, and triangles.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

1.1 Define the term, "area calculation".

1.2 State the units of measurements used in area calculations.

1.3 State the formula used to calculate the area of a:
- square and rectangle
- circle
- triangle

1.4 State the area of a square, rectangle, circle, trapezoid, and a triangle in both Imperial and SI units.

Number: S00029.2

Title: **Surface Area Calculations**

Duration: Total Hours: 6

Theory: 6
Individual/Group Work: 0
Out of Class Practical: 0

Prerequisites: S00024

Co-requisites: S00027, S00028, S00029, S00030

Cross Reference to Training Standards: U5458, U5459, U5461, U5463, U5464, U5465

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to calculate the surface areas of tanks and cylinders in both Imperial and SI units.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

2.1 Define the term, "surface area calculation".

2.2 State the unit of measurements used in surface area calculations.

2.3 State the formulas used for finding the surface area of the following shaped tanks:

- square, rectangular, and spherical
- cylindrical with flat ends and spherical ends
- hemispherical
- segments of a circle

2.4 Calculate the total surface area in Imperial and SI units of square tanks with closed and open tops.

2.5 Calculate the total surface area of a rectangular tank with closed and open tops, a coned-shaped tank with a closed and open bottom, a cylindrical tank with flat and spherical ends, and a hemispherical tank in imperial and SI units.

Number:	S00029.3	
Title:	**Volume Calculations**	
Duration:	Total Hours:	6
	Theory:	6
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00024	
Co-requisites:	S00027, S00028, S00029, S00030	
Cross Reference to Training Standards:	U5458, U5459, U5461, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to calculate the volumes of tanks and cylinders in both Imperial and SI units.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

3.1 Define the term, "volume calculation".

3.2 State the units of measurements used in volume calculations.

3.3 State the formulas used for volume calculations of the following shaped tanks:
- square or rectangular tanks
- spherical tanks
- cylindrical tanks with flat ends
- cylindrical tanks with spherical ends
- hemispherical tanks
- segments of a tank and of a pipe

3.4 Calculate, in both Imperial and SI units, the volume of square and rectangular tanks, coned-shaped tanks, cylindrical tanks with flat and spherical ends, spherical tanks, and hemispherical tanks.

3.5 Calculate, in both Imperial and SI units, the weight of the water contained in various shaped tanks with given dimensions.

3.6 Calculate, in both Imperial and SI units, the combined weight of both the water and the material used to construct various shaped tanks with given dimensions.

Number:	S00029.4	
Title:	**Percentages and Ratios**	
Duration:	Total Hours:	6
	Theory:	6
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00024	
Co-requisites:	S00027, S00028, S00029, S00030	
Cross Reference to Training Standards:	U5458, U5459, U5461, U5463, U5464, U5465	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to calculate percentages and to solve ratio and proportion problems.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

4.1 Define the terms:
- "percentage"
- "ratio"
- "proportion"
- "direct ratio"
- "inverse ratio"

4.2 Explain how these terms and definitions are used in the plumbing industry.

4.3 Perform the following mathematical operations:
- express a common fraction as a percentage
- express a percentage as a common fraction
- express a decimal as a percentage
- express a percentage as a decimal

4.4 Solve a number of problems incorporating the operations listed above.

4.5 Solve a number of problems, involving:
- ratio
- proportion
- direct proportion
- inverse proportion

Number:	S00030.0
Title:	**Trade Documentation – Level 2**
Duration:	24 Total Hours
	Theory: 8 Practical: 16
Prerequisites:	S00021, S00022, S00023, S00025
Co-requisites:	S00027, S00028, S00030

Evaluation Structure

Theory Testing	10%
Application Exercises	80%
Final Assessment	10%

Number: S00030.1

Title: **Read and Apply Information from Construction Drawings**

Duration: Total Hours: 3

Theory: 3
Individual/Group Work: 0
Out of Class Practical: 0

Prerequisites: S00022, S00023, S00025

Co-requisites: S00027, S00028, S00030

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to read and apply information from construction drawings.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

1.1 Apply the information shown on architectural drawings, structural drawings, mechanical drawings, and electrical drawings for a commercial or industrial building in order to plan the installation of a plumbing system and consider factors, such as:

- definitions
- symbols
- legends
- site and grade drawings
- floor and roof drawings
- elevation drawings
- details and notes
- schedules
- "as-built" drawings
- plumbing drawings
- piping drawings
- interference drawings

Number:	S00030.2	
Title:	**Read and Interpret Job Specifications**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00021, S00022, S00025	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to read and interpret a job specification.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

2.1 Define a "specification".

2.2 Explain the purpose of a specification.

2.3 Identify the sections of a specification.

2.4 Explain the numbering system used in a construction specification.

2.5 Identify the number and section of the specification that relates to the plumbing system installation.

2.6 Identify the other sections of the specification that may relate to the section dealing with the plumbing system installation.

2.7 Identify the other sections of the specifications for which a plumber may be responsible.

2.8 Identify the key points included in the section of the specification relating to the plumbing system installation.

Number: S00030.3

Title: Produce Various Plumbing Drawings

Duration: Total Hours: 6

Theory: 0
Individual/Group Work: 0
Out of Class Practical: 6

Prerequisites: S00022, S00025

Co-requisites: S00027, S00028, S00030

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to create a number of plumbing drawings of various complexities.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

3.1 Produce a number of isometric drawings, each of which is drawn to scale, fully sized, and fully dimensioned with both a title block and a legend. The drawings may illustrate:

- a section of a domestic water pipe system
- a section of a residential DWV system
- a section of a stack illustrating a multi-fixture stack-vented group
- a section of a horizontal branch illustrating multi-fixture circuit-vented group
- a section of a domestic water pipe serving a multi-fixture washroom group
- an elevator pit installation
- an oil interceptor installation
- a grease interceptor installation
- an acid neutralizer installation
- the DWV piping required for a commercial kitchen installation

3.2 Produce an interference drawing.

3.3 Produce a valve chart from a given drawing.

3.4 Identify how to tag pipe and valves and how to label pipe, valves, and equipment.

3.5 Produce a shop-drawing manual.

3.6 Review the components in a material list, including:
- type of materials
- quantity of materials
- list price
- net price
- material mark up, overhead, and profit

3.7 Define the term, "labour estimate".

3.8 Explain how a labour estimate may be made.

3.9 Identify the different labour estimators available.

3.10 Describe the use of a labour estimator.

3.11 Produce a material take-off sheet for a given drawing, including:
- a priced, extended, and totaled material/labour list
- determine list cost, net cost, mark up, profit, and final selling price

Number:	S00030.4	
Tile:	**Demonstrate Effective Interpersonal Relations**	
Duration:	Total Hours:	3
	Theory:	0
	Individual/Group Work:	0
	Out of Class Practical:	3
Prerequisites:	S00021, S00022, S00023, S00025	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to maintain effective interpersonal relations.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

4.1 Use effective listening techniques.

4.2 Use language appropriate for the workplace.

4.3 Use common trade terms and definitions correctly.

4.4 State the typical chain of command on a work site.

4.5 Explain trade-related problems, using verbal and non-verbal communications.

4.6 Identify and explain alternative solutions.

4.7 Seek and obtain approvals from appropriate personnel.

4.8 Explain maintenance and warranty programs.

Number:	S00030.5	
Title:	**Receive and React to Instructions**	
Duration:	Total Hours:	3
	Theory:	0
	Individual/Group Work:	0
	Out of Class Practical:	3
Prerequisites:	S00021, S00022, S00023, S00025	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to understand and carry out instructions.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

5.1 Listen to the instructions given.

5.2 Identify the key points given in the instructions.

5.3 Ask for clarification on any points that are not understood.

5.4 Repeat the instructions accurately.

5.5 Determine the feasibility and safety of the instructions and assigned tasks.

5.6 Identify the key tasks required by the instructions, including:

- selecting the required materials
- gathering the required tools
- performing the required work

5.7 Communicate with others to ensure the task is completed in a timely manner and in conformity with company and/or customer standards, specifications, and codes.

5.8 Seek clarification, if and when required.

Number:	S00030.6	
Title:	**Write Job-Related Documents**	
Duration:	Total Hours:	6
	Theory:	2
	Individual/Group Work:	0
	Out of Class Practical:	4
Prerequisites:	S00021, S00022	
Co-requisites:	S00027, S00028, S00030	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to write job-related documents, either manually or with a personal computer.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

6.1 Identify which tasks, events, or requests must be documented in a written format.

6.2 Review documents to determine what information is required for their completion.

6.3 Gather the information required to complete job documentation.

6.4 Organize the information, and complete job-related documentation to a required format.

6.5 Forward the completed documents to the appropriate personnel.

Number: S00031.0

Title: **Welding – Level 2**

Duration: 24 Total Hours

Theory: 3 Practical: 21

Prerequisites: S00021, S00026

Co-requisites: S00031

Evaluation Structure

Theory Testing	10%
Application Exercises	80%
Final Assessment	10%

Number:	S00031.1	
Title:	**Arc Welding Theory, Terminology, Equipment, Procedures, and Safety Precautions**	
Duration:	Total Hours:	3
	Theory:	3
	Individual/Group Work:	0
	Out of Class Practical:	0
Prerequisites:	S00021, S00026	
Co-requisites:	S00031	
Cross Reference to Training Standards:	U5457, U5458, U5459, U5460, U5461, U5463, U5464	

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to recognize, identify, and explain arc welding theory, terms, equipment, procedures, and safety precautions.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

1.1 Describe the shielded metal arc welding process and equipment.

1.2 Define six given arc welding terms.

1.3 Name two different types of arc welding power sources and current, and describe the advantages and disadvantages of each.

1.4 Describe the operating adjustments found on arc welding machines.

1.5 Describe the special safety requirements for the operation of an electric arc to protect against electrical shock, arc flashes, and radiation.

1.6 List and describe all equipment required for the personal protection of the operator.

1.7 Identify the parts of the welding process.

1.8 Describe two methods of striking an arc.

1.9 State the correct range of lens shade numbers for arc welding.

1.10 Explain the difference between straight and reverse polarity and how to test for polarity.

1.11 Identify the meaning of the numbers in the AWS/CSA electrode code classification.

1.12 Name four types of electrodes commonly used in the welding industry.

1.13 State the purpose of the coating on electrodes.

1.14 List the factors to be considered when selecting an electrode for a specific job application.

1.15 Describe the storage procedures for electrodes.

1.16 Read and comprehend welding symbols.

1.17 Identify common arc welding faults, and describe the methods used to control them.

1.18 State five reasons for a poor weld.

1.19 Explain two reasons for removing slag from a weld.

1.20 Explain three reasons for fusing one bead in with another.

1.21 List four factors that determine weld quality.

1.22 Explain four reasons for polarity changes.

Number: S00031.2

Title: Arc Welding Procedures

Duration: Total Hours: 21

Theory: 0
Individual/Group Work: 0
Out of Class Practical: 21

Prerequisites: S00026

Co-requisites: S00031

Cross Reference to Training Standards: U5457, U5458, U5459, U5460, U5461, U5463, U5464

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate the ability to perform arc welding procedures.

LEARNING OUTCOMES

Upon successful completion the apprentice is able to:

2.1 Select the correct electrode for the intended weld.

2.2 Safely set up and adjust the welding machine prior to welding.

2.3 Check the condition of the welding equipment for correct and safe operation.

2.4 Strike and maintain an arc.

2.5 Lay beads on mild steel plate.

2.6 Prepare, tack, and butt weld mild steel plate in flat, horizontal, and overhead positions.

Summary of Equipment Recommended for Level 2

Hand Tools:

adjustable wrench
ball-peen hammer
basin wrench
broom
calculator
caliper
caulking gun
chalk line
chisels
claw hammer
combination wrench
compass
copper tube cutter
crimpers
drywall saw
faucet seat wrench
flashlight
hacksaw
hand saw
hand threader
hex keys (set)
hole saw
knife
levels
measuring tape and markers
micrometer
pick
pipe clamp
pipe locator
pipe wrench
plastic tube cutters (set)
pliers (lineman, needle nose, water pump, channel locks)
plumb bob
pry bars
punch
ratchet
ratchet cutter
rubber mallet
scale rule
scratch awl
screwdrivers (complete set)
shovel
sledgehammer
snap cutter
socket set (Imperial & Metric)
soldering and brazing torch
spud wrench
T square
tap and die sets
tin snips (set)
torque wrench
tri square
tube flaring tools
vice grips

Portable Power Tools:

chop saw
circular saw
concrete cutter
power drills
reciprocating saw

Hoisting and Rigging Tools and Equipment:

block and tackles
chain block hoist (endless chain)
come-alongs & Tirfors™
rope/cable
shackles - varying sizes
slings and chokers
tuggers (power)
wire rope or nylon (synthetic)

Assorted Equipment:

air compressor & accessories
associated software
booster pump
builder's level
cellular phone
circular saw
computer
electrical tools
electronic leak detector
fax machine
hand pump and accessories
heat lamp
hydraulic cutter
hydrostatic pump & gauge
ladder
measuring instruments
oxy-acetylene welding equipment
pumps
steamer
telephone
testing documentation
tracing cable
two way radios
walkie-talkies

Protective Equipment:

face shield
fire blanket
fire extinguisher
first aid kit
gloves (industrial, rubber)
hard hat
hearing protection
lock-out
overalls
respiratory mask
safety boots
safety glasses/goggles
safety harness & life line

Cutting and Joining Equipment:

assembly tools and equipment
field lathes
file
hand-operated oiler
hot air gun (welder)
pipe cutter
pipe groover
pipe reamer
pipe roller
pipe stand
pipe threader
pipe vise
press-fit
Presto-lite™ gas tanks and soldering equipment
tee drill
tube bender
tube cutter
turbo torch